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# COAL FATAL

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
BUREAU OF MINES  
DIVISION OF COAL MINE INSPECTION

REPORT OF FATAL COAL OUTBURST (BUMP) ACCIDENT  
KENILWORTH MINE  
THE NORTH AMERICAN COAL CORPORATION, UTAH DIVISION  
KENILWORTH, CARBON COUNTY, UTAH

April 14, 1970

By

William Bazo  
Federal Coal Mine Inspector

E. J. Grillos  
Mining Engineer

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A. C. Moschetti, District Manager  
Coal Mine Safety District E

Code  
0201

82 ug

widow  
3:45 A.M.

Sam Vigil,  
shuttle car operator

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INTRODUCTION

This report is based on an investigation made in accordance with provisions of the Federal Coal Mine Health and Safety Act of 1969 (Public Law 91-173).

A coal outburst that occurred about 3:45 a.m., Tuesday, April 14, 1970, in a pillar block of No. 1 panel 4 east section, resulted in the death of Sam Vigil, shuttle car operator. Vigil, age 64, had 40 years' mining experience, 16 years of which were at this mine. He is survived by his widow.

The Bureau of Mines was promptly notified of the occurrence by an official of the company, and an investigation of the accident was started the same day.

Information for this report was obtained from statements of employees and mine officials and from an examination of the accident area.

GENERAL INFORMATION

The Kenilworth mine, with the main portal at Castle Gate, Carbon County, Utah, has nine openings to the surface, including an 87-foot-deep air shaft. Coal is mined from the Castlegate "D" coalbed, which ranges from 9 to 16 feet in thickness. A total of 123 men, 82 underground and 41 on the surface, is employed on three coal-producing shifts a day, 5 days a week. The daily production averaged 2,100 tons of coal, all loaded by continuous miners.

Mining development in the past, by Independent Coal and Coke Company, former operator of this mine, consisted solely of driving multiple entries with crosscuts at predetermined intervals. This development was done in the upper part of the coalbed, leaving from 4' to 6' of bottom coal. Pillar extraction, whole or partial was not done. This mining method was no doubt arrived at through their experience with spontaneous fires and excessive gas emissions following roof falls in pillar areas. Since acquiring this property, present management followed the same plan of

development except that partial pillar extraction and slabbing of front and the high side of the pillar blocks on retreat was started. Normal procedure was to leave only those pillar blocks intact where stoppings between intake and return airways had been erected, and slab two ribs on all other pillars, including a skip along the barrier pillar between each section. Similar mining (pillar slabbing) was done throughout 5 east entry, which had recently been sealed, without any apparent difficulty; however, the entire area dips 11 percent in a northerly direction, or from 4 east to 5 east which could cause shifting of stresses in this direction.

Mining operations were confined to slabbing of pillar blocks in 4 east section when the bounce occurred. The maximum coal outburst occurred in a normal size (80' x 80') block of coal outby the face area which had not been changed after first mining.

The immediate roof is firm sandstone of undetermined thickness. The vertical cover in the area being mined was approximately 1,500 feet. Bottom coal, about 4 to 6 feet in thickness, was left in place. A sandy shale stratum is found immediately below the bottom coal. Vertical cleavage planes exist throughout the coalbed requiring coal ribs to be pinned on 8- to 10-foot centers, throughout.

Members of the investigating committee were:

Company Officials

James Brophy	general manager
Donald Newberry	general superintendent
Homer Hyatt	safety engineer
Walter Jones	mine foreman
Reuben Bera	third shift foreman
William Bergamo	section foreman
LaVar Mower	section foreman

United Mine Workers of America

Frank Stevenson	president, District 22
Henry Brownfield	safety coordinator, UMWA, District 22
Harold Jewkes	president, Local 5861
Merlin Anderson	member, mine safety committee
Paul Madrigal	member, mine safety committee

The Industrial Commission of Utah, Safety Division

Frank Ularich	mine inspector
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United States Geological Survey

Jack Moffit	deputy mining supervisor
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United States Bureau of Mines

William Bazo  
E. J. Grillos

Federal coal mine inspector  
mining engineer

The general management structure of Kenilworth mine consists of general manager, general superintendent, safety engineer, mine foreman, shift foremen for each shift, and a section foreman for each production crew.

A safety department is maintained by the company for the overall direction of the safety program.

A procedure of reporting and recording all accidents that result in injuries is followed.

The Kenilworth mine had an injury frequency rate of 21.81 and a severity rate of 1203.08 per million hours of exposure in 1960. The last fatal accident occurred on November 3, 1969, and was caused from a rib fall.

The last regular Federal inspection was completed March 23, 1970.

DESCRIPTION OF ACCIDENT

The production crew entered the mine at 11 p.m., Monday, April 13, 1970, and arrived in the working area shortly before midnight.

Normal mining operations were conducted by the crew of seven men, including the section foreman, until 3 a.m. The crew began staggering their lunch period; four men continued production activities. Sam Vigil, victim, after eating his lunch, resumed controls of the Joy 10 SC shuttle car, and completed two trips to the belt tailpiece. He returned to the working area, parked the shuttle car approximately 4 feet from the low rib of the pillar block (see sketch No. 1) just outby the mining area, and sat while waiting for the other shuttle car to be loaded. A terrific coal outburst (bump) occurred in the section and from 5 to 7 feet of coal bounced off the 10-foot-high ribs of the pillar block, adjacent to the parked shuttle car. Vigil was killed instantly when struck on the back by a lump of coal weighing approximately one-half ton.

The bounce created a dense cloud of dust, impairing visibility in the immediate area. Merlin Anderson, continuous-mining machine operator, Joe Martinez, shuttle-car operator, and Arthur Saastamoinen, mechanic, but acting as continuous-mining machine helper, had to grope their way out. Anderson, while groping his way out, felt Vigil's face and could not detect any breathing. Vigil was covered by coal from the shoulder down, and could not be removed until visibility could be restored. Martinez, meanwhile, had pulled the power source to the section within 10 minutes following the bounce. Other members of the crew, including Perry Sandoval, continuous-mining machine helper, John Burnside, timberman, and LaVar Mower, section foreman, who were having lunch a short distance outby, were not injured.

In addition to the dense cloud of dust, an explosive mixture of methane was also detected at the tailpiece, 300 feet outby the working area.

Rex Jewkes, fireboss, was at 3 east section loading head and heard the bump. He advised Marion Cook, section foreman in 3 east, to telephone 4 east to determine what happened. LaVar Mower, section foreman in 4 east, answered the telephone, and reported that he couldn't see a thing nor tell where the men were. Cook and Jewkes pulled the power off 3 east section and started to 4 east section. When they arrived near 4 east, they noticed that two doors on the manway (intake) were blown shut, by the force of the bounce, and air was short-circuited from 4 east. These doors were opened and ventilation was restored in 4 east section. The bounce occurred at approximately 3:45 a.m., and it was 6:30 a.m. before visibility had improved sufficiently to remove Vigil from the seat of the shuttle car. Vigil was taken to the surface, where Dr. O. W. Phelps determined that the large aorta was severed and rib cage crushed.

The ventilating system in the mine was also affected by the bump (see sketch No. 2). A concrete block stopping, outby the squeeze seal in the breakthrough between 4 and 5 east sections barrier pillar, was ruptured; fortunately, the squeeze seal was not destroyed, but was leaking along the upper edge. Twelve concrete blocks were knocked out of the roof of 5 east overcast. The sheet iron roof of the main east overcast was bent out of shape. Leaks were evident at the squeeze seals in 5 east section. Roof conditions throughout the area were not affected.

Upon arrival in the face region of the affected section, a preliminary inspection revealed that in addition to the damage mentioned previously, methane was being liberated freely throughout the face region. The ventilation had been restored; however, dangerous quantities of methane were present. An Order of Withdrawal Form 104(a) was issued Tuesday, April 14, 1970, ordering all persons, except persons referred to in Sec. 104(d) of the Act, to be withdrawn and prohibited from entering the area. The Order of Withdrawal was terminated April 15, 1970.

A study of the sequence map, (sketch No. 3) indicated that chain pillar slabbing was sporadic. While a system was outlined it was not followed, inasmuch as in some instances the pillar sequence varied, depending on current conditions, and then only one side of a pillar was slabbed. In addition, leaving full size pillar blocks between intakes and returns in both 5 east and 4 east sections created excessive pressure on the pillar which burst and affected other areas of the mine. Slight bumping in the area was noted during the investigation and, reportedly, increased bumping was experienced the following morning, Wednesday, April 15, 1970, practically at the same hour.

#### CAUSE OF ACCIDENT

This accident was caused from mining in an area of heavy overburden and a partial pillaring plan that systematically produced pillars of unequal size causing continual shifting of stresses to the larger pillars.



## RECOMMENDATIONS

Compliance with the following recommendations may prevent a similar occurrence in the future:

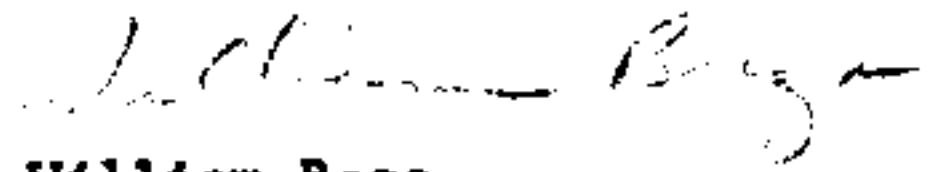
1. Management should make a thorough re-evaluation of mining methods, roof and floor conditions, and depth of cover in this mine, and discontinue pillar slabbing to provide maximum protection against coal outbursts.
2. Where complete recovery of pillars is not desired, an equal amount of coal should be mined from all pillars to insure uniform size and shape, so the stresses are distributed uniformly upon all blocks.
3. Providing protective cabs on shuttle cars should be expedited.

The following recommendation, although not directly involved in the coal outburst, is an accepted practice that should be followed when coal pillars are being mined.

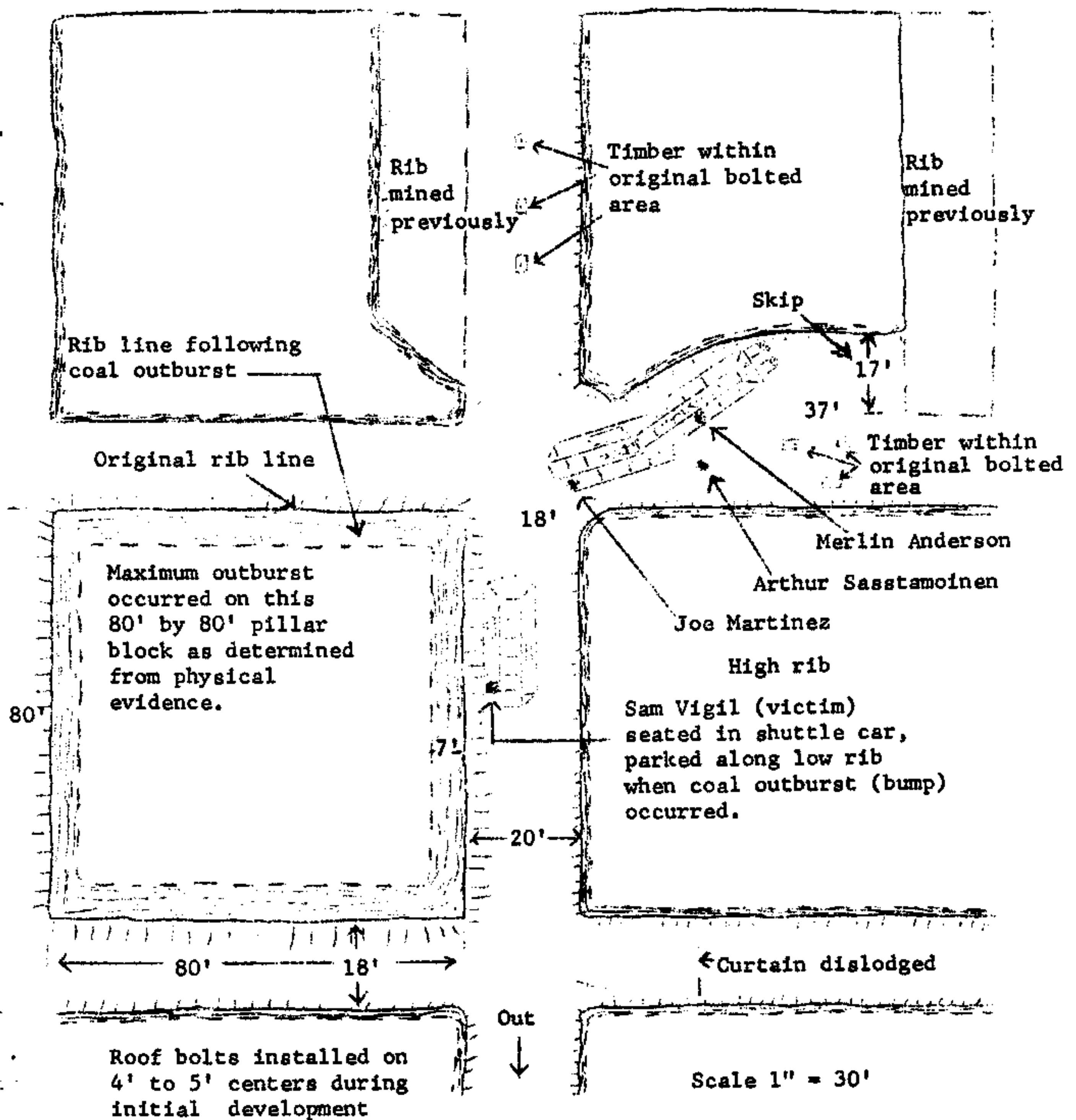
A minimum of two rows of breaker posts or the equivalent should be installed on not more than 4-foot centers across each opening leading into pillared areas.

## ACKNOWLEDGMENT

The cooperation of company officials and employees, members of the United Mine Workers of America, representatives of Industrial Commission of Utah, Safety Division, and representatives of the United States Geological Survey during this investigation is gratefully acknowledged.

  
William Bazo  
Federal Coal Mine Inspector

  
E. J. Grillos  
Mining Engineer



FATAL COAL OUTBURST (BUMP) ACCIDENT  
 KENILWORTH MINE  
 THE NORTH AMERICAN COAL CORPORATION, UTAH DIVISION  
 KENILWORTH, CARBON COUNTY, UTAH

April 14, 1970

Sketch No. 1

Pillar where maximum  
outburst occurred

Concrete block  
stopping outby  
squeeze seal  
ruptured

Bounce caused leak along  
upper edge of squeeze seal

12 concrete blocks knocked out of  
roof of overcast at 5 east entry

Bounce caused slight leaks  
on squeeze seals across 5 east  
entry

Sheet iron roof on main east  
overcast bent out of shape

Scale 1" = 500'

Sketch No. 2 Showing Areas  
Affected By Bounce

in in

KENILMORTH MINE  
THE NORTH AMERICAN COAL CORP.

UTAH DIVISION

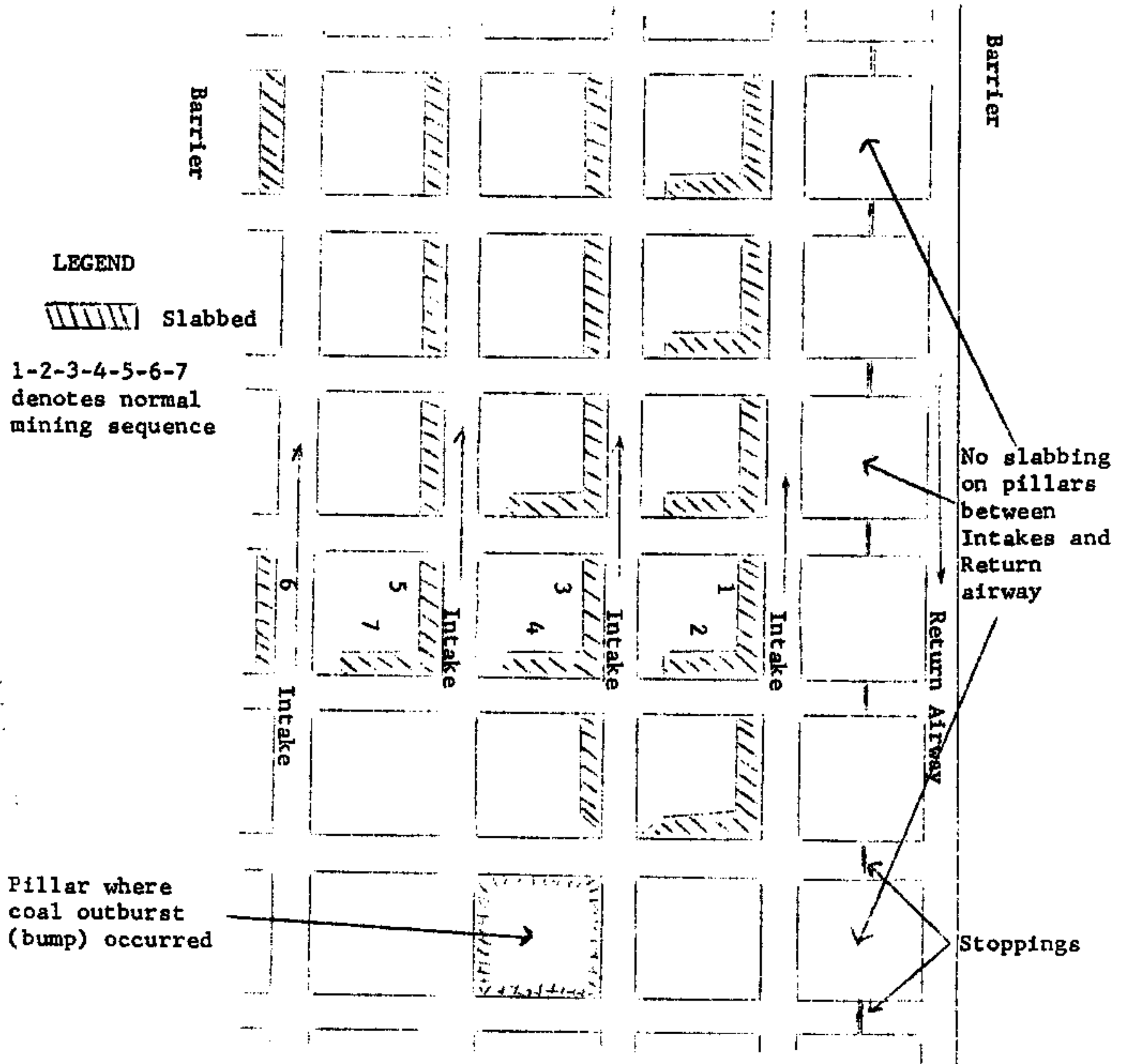
KENILMORTH, CARBON COUNTY, UTAH

April 14, 1970

Dip  
↓



Dip 5°



Scale 1" = 100'

Sketch No. 3  
Showing Haphazard Pillar Slabbing  
in  
4 East Entry  
KENILWORTH MINE  
THE NORTH AMERICAN COAL CORPORATION, UTAH DIVISION  
KENILWORTH, CARBON COUNTY, UTAH

PRIOR TO

April 14, 1970  
When coal outburst (bump) occurred

# HISTORICAL SUMMARY OF COAL-MINE EXPLOSIONS IN THE UNITED STATES

*KENILWORTH MINE*

BY H. B. HUMPHREY

\* \* \* \* \*

Information Circular 7900



*Kenilworth — Splitting pillar at corner projecting into gob,  
Classic bump scenario.*

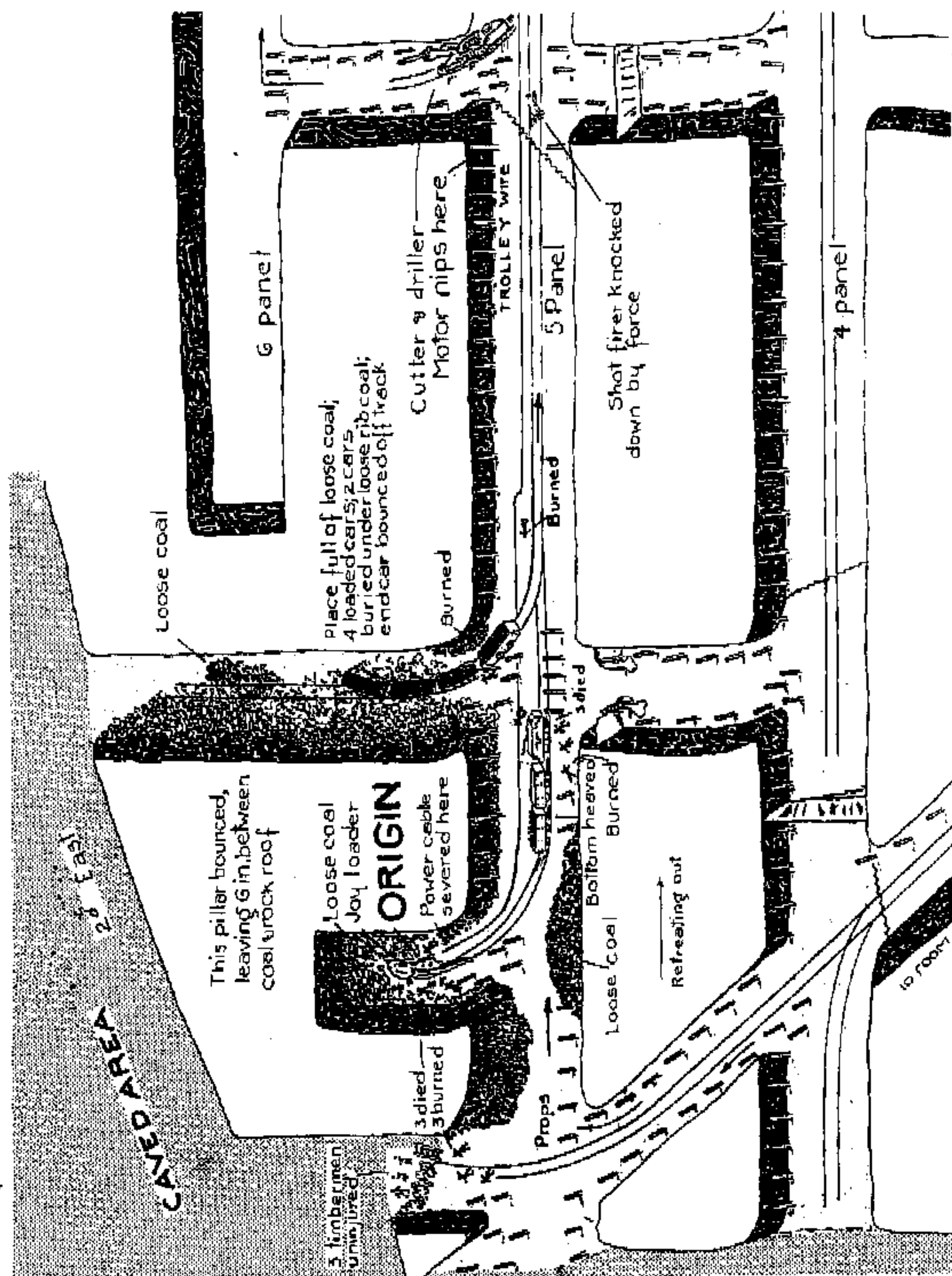


Figure 142.—Sketch of explosion area, Kenilworth mine, Kenilworth, Utah, March 14, 1945.

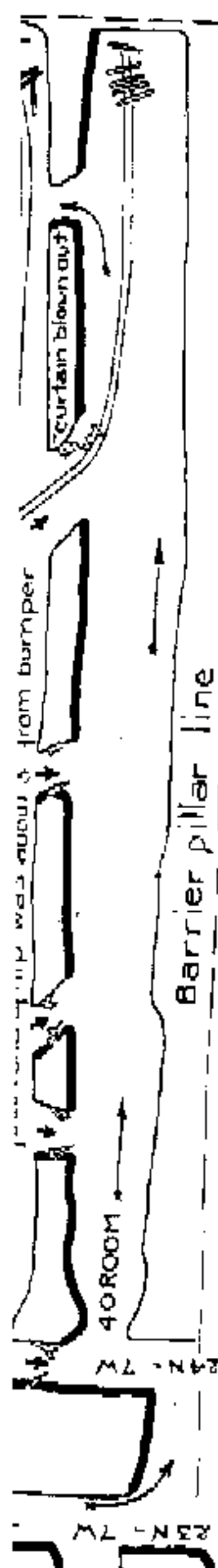
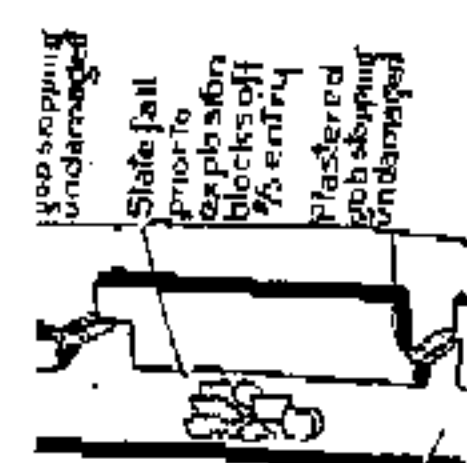


Figure 137.—Sketch of explosion area, Nellie No. 3 mine, Nellie, W. Va., November 6, 1943.

Surface breaks over the No. 1 right dip entries about 1200 feet from the main entries were made by the force of the explosion. Rescue leaders and crews arrived during the day. A mine rescue team under oxygen entered the mine about 7:30 p. m. to inspect locations for seals. Members of the fresh-air-base crew and the reserve apparatus crew were overcome by carbon monoxide at a base 50 feet outside the mine portal. It was decided to seal the mine at the drift portals. As a preliminary step the breaks over the No. 1 right dip entries were covered with earth, using a power shovel and a bulldozer. This was completed by midnight, and the temporary seals were finished by 2:15 a. m. March 26.

A second explosion at 4:00 a. m. blew out the seals and again broke the surface over the No. 1 right dip entries. Repair of these breaks again delayed erection of temporary seals until noon.

A third explosion occurred at 1:35 p. m., with six men in the drifts erecting the seals. Flame did not extend to the drift portals, but air pressure broke the frames of the seals. The crew completed the seals by 2:50 a. m. Permanent seals were installed March 28. Water from a small creek was run into the mine through the surface breaks over the right dip entries to make a water seal. On August 1 the seals were removed, and the mine was explored. The 16 bodies were removed August 2 and 3. A canvas in No. 21 crosscut between No. 2 and No. 3 entries was found propped open permitting accumulation of methane and fire fumes in the entry faces (fig. 138).

The mine was rated not gassy by the State, and coal dust had not been cleared from the workings as required by law. Rock dust had been applied over the loose coal and dust but was not adequate to protect against ignition of the dust.

#### July 28, 1944; Brilliant No. 2 Mine, Brilliant, N. Mex.; 6 Killed

(From Bureau of Mines report, by L. L. Noss, E. A. Morgan, and H. L. Scott)

About 11:00 a. m. the superintendent visited two men working on an overcast about 1,040 feet from the face of No. 5 south entry. A few minutes later he was with the assistant mine foreman in No. 7 east entry when the explosion was felt. They called the surface by telephone, and recovery operations were started immediately. Canvas was used to replace broken cinder-block stoppings and doors. Bodies of the 2 men at the overcast and of 2 electricians, a timberman, and a track layer were recovered in less than 3 hours. The first 2 bodies were at the overcast, and the 4 others were near a storage-battery locomotive at the top of a rise about 820 feet in by.

A stopping in the crosscut where the overcast was being erected had been removed that day, short-circuiting the ventilation in No. 5 south entry and aircourse. Gas accumulated and was ignited by an arc from the controller of the locomotive when it was moved to the "off" position. The force of the explosion extended from the faces of the entry and aircourse to about 300 feet out by the overcast (fig. 139). Rock dust had been applied, and coal dust was not involved.

#### January 17, 1945, Bond Valley Mine, Haileyville, Okla.; 9 Killed

(From Bureau of Mines report, by R. D. Bradford and R. L. Ellis)

Nine men were working underground. At 1:00 o'clock six had left the working faces in the 6 east entry, the counter entry, and the longwall face above to eat lunch while the machine crew and the shot firer stayed to prepare more coal for loading. The machine

crew cut about 30 feet on the longwall, which did not require blasting, and went down to eat. The shot firer loaded 1 hole in the lower side of the haulage-counter face and 1 hole in the upper side of the counter entry. He lit the fuses of both shots and had joined the other men on the entry when the explosion occurred at 1:24 p. m. The explosion traveled from the entry to the slope and up the slope to the surface, gathering force as it progressed. All stoppings between the take and return airways were blown out; the concrete overcast at the mouth of 4 east was destroyed; all supports along the main slope and the return airways were blown out, causing extensive caves of roof rock. The slope portal was blown out, and the wood air duct and fanhouse were blown apart (fig. 140). Help was called by the surface men, and officials of the State and Federal agencies and other mines arrived to work with volunteer rescue men from other mines. Ventilation on the slope was restored for about 100 feet after temporary repairs were made to the fanhouse and air duct. At that point the concentration of carbon monoxide became so high it was necessary to return to the surface. Additional repairs were made to the air duct and fanhouse, and time was allowed for the air to clear.

At 9:00 p. m. a party returned to the slope and noted a burning crossbar near the mouth of 6 east. This was extinguished with water by two men wearing gas masks, after which ventilation was restored to the face of 6 east. The bodies of the 9 men and a mule were found about 200 feet out by the face. All were moved by 9:00 a. m. January 18. The explosion was originated by the shot in the 6 east counter face, which blew out. Both of the shots were on the solid dynamite and a permissible explosive. Coal dust was ignited, and the thick deposits of dry coal dust on the slope and haulageways propagated the explosion (fig. 141, p. 204). No rock dusting had been done.

The mine was rated gassy, but apparently methane played a minor part in this explosion. Blasting of the solid when other men than the shot firer were in the mine was a violation of the Oklahoma mining law. A committee of the State legislature investigated the explosion and reported that there had been gross negligence by the operators. Seven of the 13 men working at the mine were the partners forming the cooperative company that leased the mine.

#### March 14, 1945; Kenilworth Mine, Kenilworth, Utah; 7 Killed

(From Bureau of Mines report, by W. B. Odendahl)

At 1:15 p. m. 16 men were working in No. 5 panel on the 3d east entry off No. 2 slope, when a severe bounce occurred in the pillar that was being mined next to the caved area. Although all of the electrical equipment in the panel was idle, the flying coal pulled the trailing cable of a loading machine with such force that it was severed and short-circuited on the edge of the pipe conduit entering the machine. An arc was formed that ignited the coal dust and methane in the air as a result of the bounce. Flame filled most of the area and burned 12 of the men severely. A shot firer just outside the flame was knocked down but not injured, and three timbermen also beyond the flame were not affected. The shot firer cut off power from the section and telephoned to the dispatcher for assistance. The injured men were given first aid and removed to the hospital. All men were sent out from other sections. Later seven of the injured died.

The coal thrown from 1 side of the pillar filled a crosscut to a depth above the tops of the cars, 50 inches high. A section of the pillar 60 by 40 feet had been thrown out to a depth of 6 inches below the roof. Sur-



vivors stated that the flame lasted 10 seconds or longer. The well-rock-dusted condition of the mine confined the explosion to the immediate area (fig. 142). As a precaution a method was devised later for grounding cables and fog nozzles were used to allay dust. Water saturation of pillars was also adopted.

### May 9, 1945; Sunnyside No. 1 Mine, Sunnyside, Utah; 23 Killed

(From Bureau of Mines report, by R. D. Reeder and J. H. Bird)

At 3:12 p. m. an explosion killed 23 of the 85 men in the mine, and 7 were hospitalized; the other 55 escaped unassisted. The day-shift employees were preparing to leave their places when the mine foreman on the main haulageway at 1 dip felt a heavy concussion. He telephoned the surface and cut off the power from 1 dip and 2 dip sections at the circuit breakers near 1 dip hoist. He went to 2 dip and through dust and smoke to 1 right parting, finding several men, some alive and some dead. He came back to the haulageway and organized a small rescue party and led them down the dip to 1 right. The air had cleared somewhat, and they were able to revive 7 of the 11 men found. The injured were removed to a hospital. All of the 11 had been overcome by carbon monoxide and were not burned.

Rescue crews and leaders arrived and restored ventilation in the affected area and removed 19 bodies by the morning of May 10. Much of the work was done by oxygen-breathing apparatus crews. Flame and violence were confined to part of 1 right and 2 left and 3 left entries off 2 dip. Doors, stoppings, and overcasts were destroyed, and timbers were dislodged. Gas had accumulated in the 3 left back entry from feeders uncovered by blasting earlier in the day. A line curtain had been put up to clear this face, but the curtain was found pinned up 2 or 3 times that morning. Other curtains and doors in the section were also opened and left open without regard for the effect on ventilation. The point of ignition was probably in the 3 left back entry near the least crosscut. The source of ignition may have been a carelessly handled flame safety lamp, an arc from the motor or switch at a pump, or smoking (fig. 143). Coal dust was raised and ignited, but the explosion was localized by rock dust that had been applied 4 days earlier.

### December 26, 1945; Belva No. 1 Mine, Fourmile, Ky.; 25 Killed

(From Bureau of Mines report, by M. J. Ankeny, M. C. McCall, and C. H. Dodge)

The mine power failed for a few minutes about 7:10 a. m., soon after the last man-trip entered the portal. On reaching 5 left off 9 right, 6 cars were placed in the 3 working places before the locomotive crew felt the explosion about 8:20 a. m. After gathering the other seven men in 5 left they started toward 9 right entry but were stopped by dense smoke at 1 left off 5 left. They then went back to 5 left and walked around to find a suitable place to stay. They entered 2 left off 5 left and stayed until about 4 o'clock that afternoon, when they made a futile attempt to find a way out through breathable air but found all openings into 4 left caved. They came back to 2 left off 5 left with difficulty, where they remained until about 9 o'clock on the morning of December 27, when they started out 5 left. They entered 9 right and walked nearly to 4 left, where the leader collapsed. Although the smoke had disappeared, the air still contained carbon monoxide and was low in oxygen. Two of the party dragged the man back until he was able to crawl, and all retreated to 2 left off 5 left. On their

way they placed boards in 5 left with chalk-marked directions to their location in 2 left. About 11:30 a. m. they took an old door that had been torn off its hinges and pushed it over the opening to the room in which they took refuge. It kept out much of the smoke that was then entering. At times they felt considerable heat, but air kept coming in from some place on the aircourse. The changes in temperature and atmosphere were caused by the flaring up of fresh fires and their extinguishment and changes in ventilation made by rescue crews as they progressed against terrible hazards.

An electrician on the surface saw smoke and dust rolling out of the haulage portal at 8:20 a. m. He reported this to the superintendent and tried to close the circuit breaker in the substation, but it would not stay closed. The breaker had opened before the dust and smoke appeared. The superintendent notified State, Federal, and other mine officials who arrived during the day. The main fan continued to run, although the casing was moved inward about 3 inches by the detonation wave, but the stoppings between the haulageway and the intake airway were destroyed or damaged. The caved old workings used as the intake airway could not be traveled, so the fan was reversed at 12:30 p. m., and work was started on rebuilding stoppings with the few men available. An exploration party traveled about 2,000 feet of the main haulageway and extinguished several small fires.

During the recovery work at least 22 fires were found and extinguished. In order to obtain enough air to clear the smoke from the haulageway beyond 7 left, tight wooden stoppings had to be built in about 50 onby crosscuts. Gas-mask crews explored the caved workings and put out fires. While ventilation was being restored on the straight main haulageway inby 9 right, an exploration of 9 right was made for 1,000 feet before encountering heavy afterdamp. Caved airways prevented exploration from the straight mains and greatly reduced the air flow. An exploration party in 9 right on December 28 found footprints at 4 left and noted chalkmarked boards, indicating that men were in 1 left off 5 left. The door over the room entrance was moved, and the unconscious men were found about 1:30 p. m. The advance party, without gas masks, became distressed, and some were unable to walk. Help was summoned, and the ventilation was changed to put fresh air into 5 left and then into 9 right. One of the 9 men was dead; the 8 survivors were given oxygen and other treatment in the mine and removed to a hospital; 1 died the second day, another after several months, and the other 6 men lived.

Attempts to force air into 6 left and explorations by oxygen breathing apparatus, and gas-mask crews were halted when a fire about 2,000 feet from the portal destroyed a stopping. The fire was extinguished and the stopping rebuilt. Gas-mask crews reached the entrance to 6 left section, but ventilation was inadequate to clear the afterdamp and methane encountered. It was evident that no victims could be alive in the section and that the situation had become too dangerous for further recovery work because of gas and fires. The mine was sealed at the drift mouth on January 3, 1946.

On August 5, 1948, the seals were removed, and the fan was operated. Falls were cleared and stoppings repaired. By October 21, 20 bodies were found and removed, making a total of 25 dead of 31 men who were in the mine (fig. 144, p. 208). The explosion was not violent, except in the 6 left aircourse off 9 right. At this location, a blower fan, a conveyor-drive unit and loading head, and the wiring and controls were moved violently and damaged by the forces. Elsewhere all but 3 stoppings between the main intake and return airways were destroyed and several doors were smashed.